ANGEO Meeting

September 14, 2009

Northwestern University

Pre-meeting:

Read the proposal; prepare to discuss coding rubric and student responses for HW 1 assignment.

9:00am – 12:00pm: Session 1

Review of proposal: What do we think we can accomplish?  Are there things we want to drop?  Add?

a. How will the analogy training work, and what will the control group get?

We agreed to keep the lectures and readings the same for both groups. We will inventory the analogies and take things out as we agree upon them. The treatment/control will both be trained on causal relationships using Cause-Map (MSU) and/or Cause-Sys (NU). There will be analogies on activities, homework and assessments.

5 component process for using analogies:

1. Retrieval: can’t be trained directly, but may improve through analogical training
2. Mapping: similarities and differences
3. Evaluation: which one is better, and why?
4. Abstraction: how a analogy (source) feature abstracts a feature of the target
5. Re-representation: the model that maps features between source and target

Procedure for developing learning materials:

Backwards Design: (Wiggins & McTighe)

* Goals for the course
* Assessment instruments (borrow, adapt, create instruments)
* Develop curriculum
* Implement/Assess

**Molecular-kinetic causation is the common causation throughout the course.**

**TRAINING: ANALOGY GROUP (EXPERIMENTAL)**

Do training that goes through different kinds of analogical tasks. Keep those tasks constant.

*Purpose of work is to use analogies to facilitate reasoning.*

A. Mapping Training

Use table and correspondences.

1. Easiest: Give them starting correspondences…
2. Easier: Give them just relevant elements….
3. Harder: Give them all pieces of the systems that are being compared…
4. Hardest: What is common? What is different? Building the analogy…

Do the analogy training and ramp them by making sure they can’t fail. Give them easy mappings, give some correspondences. Then they do the correspondence themselves, then give them harder.

B. EVALUATION TRAINING

“Shove analogies up against the wall until the analogy breaks down”

C. NEED TO TEACH STUDENTS TO ANSWER QUESTIONS ABOUT EACH CONCEPT

Blanket (tropopause like blanket)

Greenhouse (tropopause like glass)

Microwave (tropopause like walls) – not as literal

Inputs vs. outputs

“emissions”… is this input/output

Analogies are valuable in scientific reasoning

No analogy is perfect – just as important to know where they break down as where they are powerful. Same with scientific models.

Review of rubrics and student responses to for questions (HW1): \*\*didn’t discuss this\*\*  
Getting drunk is similar to....because.....  
A balloon floating in air is similar to.....because...  
Water freezing is similar to.....because.....  
Catching a cold is similar to....because.....

Discussion of definitions: what defines an analogy, similarity, causal relationship, etc.

SEE FIGURE IN PPT (ANALOGYGRAPH.PPTX)

Analogical training: Theory points for discussion: a. Claims: (1) Analogical mapping can be directly trained, but analogical retrieval cannot.

(2) However, analogical retrieval benefits from better domain encoding—specifically, from uniform relational representation (Loewenstein et al 2009; Gentner, 2010)

(3) Improving people’s habits of analogical mapping is a good way to improve the domain representation, including uniform rel. rep.

So, (4) to improve relational retrieval, focus on analogical mapping skills [and of course on domain knowledge, but that will occur for both experimental and control groups]

GENERATE A WORKBOOK AND SET OF EXERCISES (FOR IN CLASS) THAT TRAIN STUDENTS TO WORK WITH ANALOGIES

“Scientists learn to value causation”…do students not understand cause, not value cause, or not understand what we mean by cause, or don’t retrieve domain model that is causally similar.

**ASSESSMENT**

Maybe qualitative ontologic coding

We should use the A is like B problems as a pre-post test… but we should not necessarily use analogies for which they are not going to learn more content about these topics. Some examples that demonstrate content gains, some that demonstration gains on non-course related content, and then non-analogy content

End of course improve causal mapping

1. analogical reasoning about non-domain material
2. analogical reasoning about the domain
3. conceptual understanding about global change (concept inventories)
4. model/scientific/analytical reasoning

LITERAL SIMILARITY: A blue balloon floating in air is like a green balloon floating in air

MERE APPEARANCE: A blue balloon floating in air is like a green ball floating in water

ANALOGY:

NO MATCH:

Using the Wiki (Nicole) – need projector and screen

Weekly updates from MSU, NW, Duncan (Fri at 10)

Twice monthly Skype call

Add Garret to Wiki

Review of work plan:

A. Pre- post assessment plan

1. KNOWLEDGE

GCI – CLIMATE CHANGE CONCEPT INVENTORY

Lecture for both groups needs to be exactly the same. Course designed prior – intent of conveying material, so some real discussion of analogies, some not.

Roles of personnel

Week by week material: Duncan

Water cycle

Calcium cycle

Carbon cycle

For future meetings, copy Garret – he’s the lab manager and makes reservations for housing, etc.

CAUSESYS (potential assessment)

Timeline for work plan.

**TIMELINE AND WORK PLAN**

\*Lead is listed although all people may be involved, and all three groups collaborate and review materials.

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| --- | --- | --- | --- |
| **TASKS** | **NORTHWESTERN (DEDRE, MICAH, ETC)** | **MICHIGAN STATE**  **(NICOLE, JULIE)** | **MICHIGAN STATE-SANTA FE**  **(DUNCAN)** |
| Inventory all analogies in course, readings, etc. Key analogies in particular |  |  | Duncan |
| Coding of analogy inventory based on NW dimension scale | Micah put coding rubric on Wiki |  |  |
| Comparison of everyday analogy coding | Micah | Nicole |  |
| Place coding inventory on Wiki | Micah |  |  |
| Collection of data from experts at GSA; across expert-novice continuum |  | Julie | Duncan |
| Narrow main goals and concepts course: Elaborate C cycle, Ca cycle, H2O cycle goals; cross-system goals (equilibrium, systems, reservoirs) | Dedre/Micah third  ITERATE | Julie/Nicole second  ITERATE | Duncan first  ITERATE |
| Come to common understanding of language/rules for content | Dedre/Micah second  ITERATE | Julie/Nicole second  ITERATE | Duncan first: 10 rules posted to Wiki  ITERATE |
| List major analogs for C, Ca, H2O |  |  |  |
| Evaluate first-order efficacy of goals and box-arrow diagrams from Duncan | Micah understanding and questions | Nicole understanding and questions |  |
| Create Analogy workbook | Micah |  |  |
| Create CAUSEMaP workbook to parallel Analogy workbook |  | Nicole/Julie |  |
| Assessments (in-class activities, homework, exams- includes pre/post). Mixed methods | 1. Domain independent analogy assessments 2. Domain indep scientific reasoning | 1. Domain dependent analogy assessments 2. Domain indep scientific reasoning 3. GCI – climate |  |
| Follow-up two years later with post-test |  | Julie |  |
| Interviews/Think aloud protocols | Dedre’s posted to Wiki | Julie’s posted to Wiki |  |
| Give NW access to GCI & LON-CAPA |  | Julie |  |
| Scan Buckley Book to searchable PDF |  | Nicole |  |
| CauseMaP diagrams to NW |  |  | Post to Wiki |
| Update glossary | Micah leads | Create and place on Wiki  Nicole leads |  |
| Qualitative Reasoning Rubric | Dedre |  |  |
| Project website |  | Julie |  |
| Consider future projects - Everyone! |  |  |  |

Determining how “experts” use analogy